

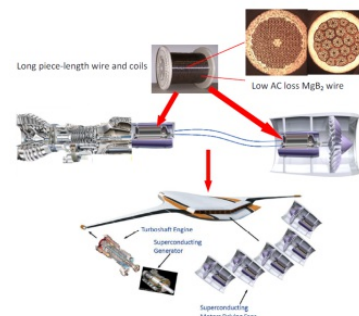
FINE-FILAMENT MAGNESIUM DIBORIDE SUPERCONDUCTOR WIRE FOR TURBOELECTRIC PROPULSION SYSTEMS, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



ABSTRACT

This SBIR Phase II proposal overcomes technology barriers for developing highly efficient all electric aircraft systems for the future, with limited impact to the environment. Turboelectric propulsion for aircraft applications is envisioned, and cryogenic and superconducting components are sought. In particular, low AC loss superconducting wires for the stator windings and superconducting wires with filaments less than 10 micrometers in diameter are of interest. There is an intense push in the aircraft industry to ultimately develop an all-electric aircraft, with liquid hydrogen and fuel cells being considered as the prime generation source for aircraft propulsion. The U.S. is in competition with Europe for the development the next generation all-electric aircraft. Superconductivity especially magnesium diboride (MgB₂) superconductors are considered an enabling technology that is being investigated by NASA, Air Force, Rolls-Royce, Airbus and EADS. This means the need for a low cost, low AC loss (fine filament superconductor) that can operate in the 10-25K temperature range in 0-2 tesla fields for superconducting stators for motors and generators. This wire is need by 2016-2017 time frame so all cryogenic motors and generators can fabricated and tested in the NASA test bed. In the Phase I Hyper Tech has shown that fine filament MgB₂ wires can be fabricated and there is potential for low AC losses in the 60-400 Hz range for stators. In the Phase II Hyper Tech will continue to work on developing, manufacturing, and testing fine filament MgB₂ wire. The wires will also be twisted to reduce coupling losses. The wires will be tested for their superconductor and engineering current density and AC losses. The result of this work will be a low AC loss MgB₂ superconductor wire for enabling all-electric aircraft development and allow the U.S. industry to lead the world in this needed and rapid developing technology.

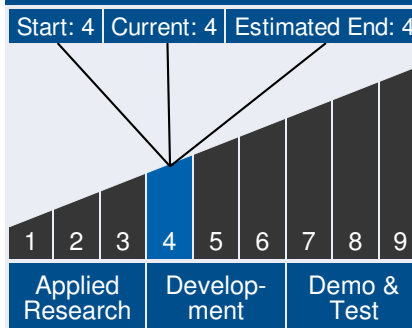


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Technology Maturity



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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Besides stator coils for the all-electric aircraft, magnesium diboride superconductors can benefit NASA for many applications where light weight power components are required such as generators, motors, transformers, inductors, power conditioning equipment and ADR coils. Other magnet applications that magnesium diboride wires can be considered for are magnetic bearings, actuators, MHD magnets, propulsion engines, magnetic shielding in space, and magnetic launch devices.

To the commercial space industry:

Potential Non-NASA Commercial Applications: For Non-NASA commercial applications, MgB₂ superconductor wires for DC applications are: rotor coils for motors and generators, background magnets for MRI systems to eliminate liquid helium bath cooling, inductive type superconducting fault current limiters. Low speed 5-20 MW direct drive wind turbine generators. For AC applications fine filament MgB₂ wire being developed in this Phase II would benefit 50-400 Hz stators for generators and motors, transformers, reactors, inductors, and resistive fault current limiters.

Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Project Manager:

- Jeffrey Trudell

Principal Investigator:

- Matthew Rindfleisch

Technology Areas

Primary Technology Area:

Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

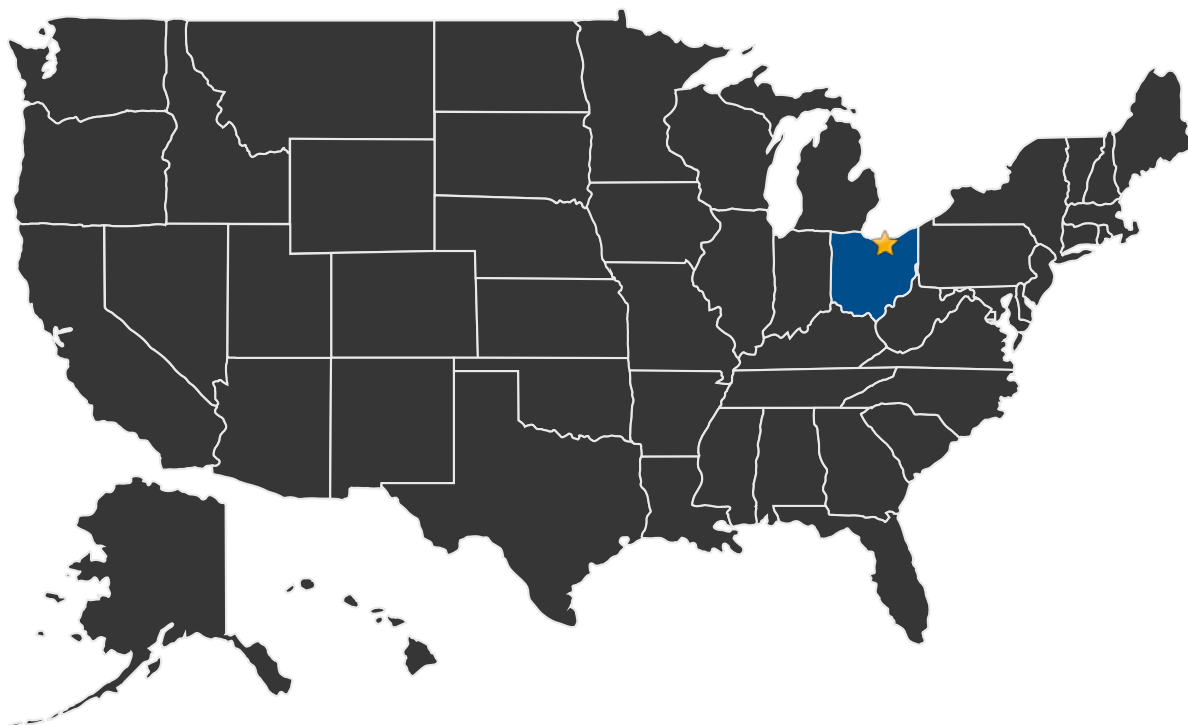
- └ Materials (TA 12.1)
 - └ Special Materials (TA 12.1.5)
 - └ Power Generation and Energy Storage Material (TA 12.1.5.3)

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work ★ **Lead Center:**
Glenn Research Center

Other Organizations Performing Work:

- Hyper Tech Research, Inc. (Columbus, OH)

PROJECT LIBRARY

Presentations

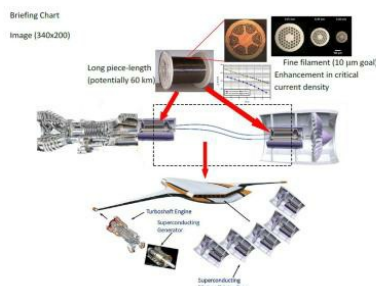
- Briefing Chart
 - (<http://techport.nasa.gov:80/file/23079>)
- Final Summary Chart
 - (<http://techport.nasa.gov:80/file/23810>)

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IMAGE GALLERY



*FINE-FILAMENT MAGNESIUM
DIBORIDE SUPERCONDUCTOR
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DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

Besides stator coils for the all-electric aircraft, magnesium diboride superconductors can benefit NASA for many applications where light weight power components are required such as generators, motors, transformers, inductors, power conditioning equipment and ADR coils. Other magnet applications that magnesium diboride wires can be considered for are magnetic bearings, actuators, MHD magnets, propulsion engines, magnetic shielding in space, and magnetic launch devices.